



COLORADO

Division of Reclamation,
Mining and Safety

Department of Natural Resources

1313 Sherman Street, Room 215
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RE: *Packer Testing Results, Red and Bonita Mine, San Juan County Colorado*

Reconnaissance and mapping of the underground workings of the Red and Bonita mine conducted during 2012 and 2013 identified a location 265 feet in by the mine portal as the ideal location for a water impounding concrete bulkhead (DRMS, 2014). The rock at this location is intensely jointed, and although the joints are tight, it was determined that packer testing to determine the permeability of the joint was a prudent step in the bulkhead feasibility evaluation. On September 9 and 10, 2014, four packer test holes were drilled into the north and south ribs of the mine near the proposed bulkhead location, and packer testing conducted in each hole. The northeast and southeast holes took negligible amounts of water during packer testing, demonstrating that the rock at the hole locations is essentially impermeable. The Secondary Permeability Indices for the northwest and southwest holes are calculated as follows.

Secondary Permeability Index (SPI) equation (Azimian, 2013):

Where:

C is a constant = 1.49×10^{-10}

l = length of test section in meters

r = radius of test hole in meters

Q = volume of water take during test in liters

t = duration of test in seconds

H = water pressure in meters of head

For the southwest packer test hole:

l = 7 ft. = 2.13 m.

r = 1 in. = 0.0254 m.

Q = 1.15 gal. = 4.35 l.

t = 900 s.



$H = 98 \text{ psi} = 68.92 \text{ m.}$

For the northwest packer test hole:

$l = 7 \text{ ft.} = 2.13 \text{ m.}$

$r = 1 \text{ in.} = 0.0254 \text{ m.}$

$Q = 4.46 \text{ gal.} = 16.88 \text{ l.}$

$t = 900 \text{ s.}$

$H = 99 \text{ psi} = 69.62 \text{ m.}$

Azimian (2013) defines the following classes of rock based on SPI.

Class A: If rock permeability (based on SPI) is $2.16 \times 10^{-14} \text{ l/s.m}^2$ or less, it is placed in class A, impermeable and the best class of rock that does not need improvement.

Class B: If the permeability is in the following ranges, $2.16 \times 10^{-14} \leq \text{SPI} \leq 1.72 \times 10^{-13} \text{ l/s.m}^2$ permeability is low and only local improvement may be needed.

Class C: If the permeability is in the following ranges, $1.72 \times 10^{-13} \leq \text{SPI} \leq 1.72 \times 10^{-12} \text{ l/s m}^2$, rock improvement is indicated.

Class D: If the permeability (based on SPI) is greater than $1.72 \times 10^{-12} \text{ l/s.m}^2$ the rock needs to be widely improved.

The rock penetrated by the two upstream holes in the Red and Bonita falls into Class A. The rock in the southwest hole is Class B and the rock in the northwest hole is Class C. Based on these results and the proximity of a free rock face to the test locations, formation grouting prior to bulkhead installation will not be necessary.

References:

Azimian, A. and Ajalloeian, R., 2013, "Comparison between Lugeon with Secondary Permeability Index

obtained of Water Pressure Test in Rock Masses," in Electronic Journal of Geotechnical Engineering, Volume 18.

Colorado Division of Reclamation, Mining & Safety (DRMS). 2014. "Preliminary Evaluation of Feasibility for Water Impounding Concrete Bulkheads, Red and Bonita Mine, San Juan County Colorado." August 19, 2014.